JAPAN

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JIS Z 8513 (2006) (English): Ergonomics -- Office work with visual display terminals (VDTs) -- Visual display requirements

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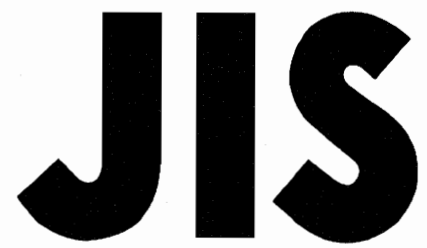*The citizens of a nation must honor the laws of the land.*
Fukuzawa Yukichi

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JIS

JAPANESE INDUSTRIAL STANDARD

JIS Z 8513 : 2006

(JES/JSA)

Ergonomics—Office work with visual display terminals (VDTs)— Visual display requirements (Amendment 1)

JIS Z 8513 : 1994 has been revised under date of June 20, 2006.
The revised items are included in this Amendment 1.

Foreword

This translation has been made based on the Amendment to the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Ergonomics Society (JES)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14. Consequently **JIS Z 8513** : 1994 is partially replaced with this Amendment.

This Amendment has been prepared based on Amendment 1 to **ISO 9241-3** : 1992 *Ergonomic requirements for office work with visual display terminals (VDTs)—Part 3: Visual display requirements* published in 2000 with some modifications of the technical contents.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

Date of Establishment: 1994-12-01

Date of Revision: 2006-06-20

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Investigated by: Japanese Industrial Standards Committee

Standards Board

Technical Committee on Consumer Life Products

In the event of any doubts arising as to the contents, the original JIS is to be the final authority.

Ergonomics—Office work with visual display terminals (VDTs)— Visual display requirements (Amendment 1)

Introduction This Amendment has been prepared based on Amendment 1 to the **ISO 9241-3** : 1992 *Ergonomic requirements for office work with visual display terminals (VDTs)—Part 3: Visual display requirements* published in 2000 with some modifications of the technical contents.

JIS Z 8513 : 1994 is revised as follows:

1—(Modification given in this clause of the Japanese version of this Amendment is not relevant to the English version.)

2 Add the following to the last sentence in clause **0** "Introduction":

Annex C forms a normative part of this Standard. Annexes A, B and D are for information only.

In addition, the portions underlined with dots in this Standard are the matters in which the contents of the original International Standard have been modified. A list of modifications with explanations is given in Annex 2 (informative).

3 Insert the following at the end of the clause of "Scope".

NOTE :   The International Standard corresponding to this Standard is as follows.

In addition, the symbols which denote the degree of correspondence in the contents between **JIS** and the relevant International Standard are IDT (identical), MOD (modified) and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

ISO 9241-3 : 1992 *Ergonomic requirements for office work with visual display terminals (VDTs)—Part 3: Visual display requirements* (MOD)

4 Replace **7.1** with the following:

7.1 Conformance with this Standard is achieved by meeting all the mandatory requirements of clause **5**.

Where the physical measurements required to comply with clause **5** cannot be carried out because the display under test uses a new technology that makes the metrological measurements difficult or impossible, conformance is achieved by obtaining a positive result using the test method and associated mandatory requirements specified in Annex C.

5 Delete **7.2 e)** and Note in **7.2**.

6 Replace Annex C with the following:

Annex C (normative)
Visual performance and comfort test

C.1 Principle

C.1.1 Purpose and use (of this Annex) This Annex describes a procedure for testing the visual quality of VDTs where the entire set of physical requirements (defined in clause **5**) cannot be applied, for example, to novel display technologies such as new types of flat panel display (such as electroluminescent and field emission displays). The test consists of a search task and an assessment of visual comfort. The combination of test results will be referred to as the visual quality of a display.

C.1.2 Intent and scenario (of this Annex) The intention behind this Annex is to provide a test method for displays that cannot otherwise be tested for conformance with the text. This test method is not an alternative test method, in the sense that a display manufacturer can choose either the physical requirements specified in clause **5** or this method. Instead, the test method provides a testing route for displays that cannot be tested according to the requirements specified in clause **5** because the display under test uses a new technology that makes the metrological measurements specified in clause **6** difficult or impossible (see **7.1**).

C.1.3 Overview of test method This test procedure measures the effectiveness of the transfer of visual information in terms of participants' search performance for targets embedded in alphanumerics on a candidate display versus those same participants' performance for such a task on a benchmark display. Effectiveness in this context means that the user is able to detect and recognize the visual targets accurately, quickly and without visual discomfort. If the display passes this particular visual search and rating performance test, it can be assumed capable of other presentations of information such as (but not limited to) non-alphanumeric languages and business graphics. The dependent variables of the test are the search velocity achieved by the test participants in a visual letter search task and subjective ratings of visual comfort using a category scale. The combination of the test results will be referred to as the visual quality of a display. Testing takes place in a simulated office environment, with test participants representative of the anticipated user population.

The method i.e. a letter search task applying pseudo-text in combination with scaling of experienced visual comfort, was first developed and tested by researchers of the IPO, Center for Research on User-System Interaction (Boschman & Roufs [3]).

The visual quality of a display, referred to as a test display, is assessed against a benchmark display known to meet or exceed the mandatory requirements of clause **5** of the text. Both the velocity in the visual search task and the subjective ratings must meet certain minimum requirements for the test display to pass. Sequential statistics, or an equally robust equivalent statistical procedure, are used to determine if the participant's performance on the test display exceeds or falls short of performance on the benchmark display.

C.1.4 Avoidance of bias All tests are open to bias, and this is especially true in the area of psychological testing. The assessment should therefore be carried out under the supervision of those qualified to carry out such testing, with the necessary education and at least one year of experience. Rules governing the ethical conduct of human experimental testing should be followed. Examples of such rules can be found in the American Psychological Association (1990)[23] and the British Psychological Society (1991)[27].

The test administrator should ensure that all potential sources of error are minimized or controlled. The following list describes some potential sources of bias and error; the list is not intended to be complete.

— Selection of test participants (e.g. avoid selection of particular age groups).

— Configuration of displays (during the test, the benchmark display shall meet all the requirements of clause **5** of the text).

— Environmental conditions (lighting and other conditions shall be equal for both displays, to avoid detrimental conditions for one of them).

— Instructions to the test participants (these should be impartial).

C.2 Test participants Test participants should be a sample representing the anticipated user population (those who perform office tasks as specified in the scope of the text). All test participants shall have near visual acuity that is normal, or corrected to normal, at the design viewing distance and shall be without any obvious physical or physiological conditions that could influence either their search performance or their perceived image quality.

C.3 The displays The test display shall be a production or full-feature pre-production unit. It shall incorporate all anti-glare and reflection filters and treatments that will be in the production unit. The benchmark display shall be supplied or nominated by the supplier of the test display and shall meet or exceed all mandatory requirements in clause **5** of the text.

The display may be labelled for identification purposes (e.g. "Display 1" and "Display 2"). Under these conditions, the test participants should not be informed which is the test and which is the benchmark display, so half of them should have the test display labelled as "Display 1" and the other half should have the benchmark display labelled as "Display 1".

C.4 Test workstation and environment

C.4.1 General requirements The test shall be conducted in an area that is free from distractions and external interference which could influence the test results. The ambient conditions shall fall within the range defined in **ISO 9241-6**. These conditions shall be comfortable and shall not be subject to significant variation during the test, both within a test participant's session and between test participants.

C.4.2 Environment The thermal environment, the background noise level, the ambient lighting, and the reflectance of work surfaces shall meet the minimum requirements in **JIS Z 8515** and **ISO 9241-6**. The ambient illumination shall be designed to

minimize glare and specular reflections (see **JIS Z 8517**). Constant lighting conditions shall be maintained both within a participant's session and between test participants. The test participants shall be light-adapted by being placed in the test room for 10 min prior to the test.

> NOTE : This period may be used by the experimenter to instruct each test participant about the test.

C.4.3 Workstation for the test The display and associated equipment (for example, the keyboard) shall be supported by a work surface that meets the requirements of **JIS Z 8515**.

For both the benchmark display and the test display, the viewing distance shall be set according to their design viewing distance. This distance should be constrained by a head-and-chin rest, the height of which is adjustable. The individual height adjustments for the test participants should be such that for both the test display and the benchmark display, the position of the eyes with respect to the display is equal for all test participants. The position of the test participant's eyes shall comply with the line-of-sight angle requirements in **5.2** of the text.

The brightness and contrast settings of the benchmark display shall be specified by the manufacturer who nominates the display: at these settings it shall meet or exceed all mandatory requirements in clause **5** of the text.

> NOTE : A measurement procedure for specifying brightness and contrast is given in the text.

According to the manufacturer's wishes, the brightness and contrast settings of the test display should be either

a) fixed at settings specified by the manufacturer, or

b) adjustable by test participants to their personal optimum settings.

Both displays shall be allowed to warm-up for at least 20 min prior to the test.

The test participant shall be seated in a chair that meets the requirements of **JIS Z 8515**.

C.5 Methods

C.5.1 Test material The test material shall be pseudo-text generated from a character set associated with an 8-bit single-byte coded graphic character set as given in **ISO/IEC 8859**, which describes a collection of character sets for various languages. If a system cannot display text in an alphabet familiar to the users, text should be displayed by double-byte coded characters (e.g. Asian characters). In this case, the language used shall be specified in the compliance statement. Each test will use a specified character subset (e.g. "A" ... "Z", "a" ... "z", and "0" ... "9"). The same subset shall be used for both displays.

Pseudo-text shall be generated from the character set according to the following constraints.

— Pseudo-texts shall consist of blocks of random strings of characters separated by spaces.

— The texts, on both test and benchmark display, shall consist of a constant number of lines and a constant number of characters per line (including space characters).

— The number of characters per line shall be chosen so that the line length (in centimetres) is less than 25 times the line-to-line distance (i.e. the height of the display area divided by the maximum number of lines). However, a line should contain at least 30 characters (including embedded spaces). The total number of characters in a pseudo-text shall be between 400 and 600, embedded spaces included. The pseudo-text blocks (see **C.5.2**) shall be sized such that, if 5 blocks could be displayed at once (one in each corner and one in the middle), they would have minimum overlap while maximizing coverage of the display area. In the case of using 2-byte characters, the total number may be half of the number specified above.

— Each test participant is instructed to count the occurrences of a single target character over the entire test (e.g. test participant x is instructed to search for "A"s during the entire test, test participant y is instructed to search for "R"s, ..., etc. In the case of using 2-byte characters, the test participant is instructed to search for, " ム "s, in Japanese.).

Information : " ロ " shall not be the target character because it can affect the test results (the same applies to ン, ソ, 口, コ, り, リ).

— The number of targets shall be 2 % to 3 % of the total number of characters in the text, including embedded spaces.

— The position of the targets shall be randomly chosen with the restriction that a line may not start or end with the target character.

— The texts shall contain a constant number of spaces. The space fraction shall be 15 % (i.e. the number of spaces relative to the total number of characters, including embedded spaces). Although the average word length does vary over different languages, pseudo-texts with 15 % space fraction, in a way, do resemble normal texts with respect to their string length distributions.

The position of the spaces shall be randomly chosen with the following restriction:

a)   a line shall neither start nor end with a space character (all spaces are embedded);

b)   a space character shall not be adjacent to another space character (strings are separated by single spaces);

c)   the minimum string length shall be 2 characters.

C.5.2 Procedure   Display pseudo-text as a block of characters in one of five screen locations. The test participant's task is to scan the text and identify the presence of the target character.

Place the blocks of pseudo-text in the upper left, the upper right, the lower left, the lower right and the centre of the screen. Locate the centre block so that the middle character of the block is approximately in the centre of the active area of the screen. Place text in each of the four corners so that it abuts the extreme corners of the screen.

Tell the test participants that the objective of the test is to evaluate the quality of the image on the display. If, for the purposes of the experiment, the manufacturer of the test display has decided that the brightness and contrast controls may be adjusted by test participants, give the test participants the opportunity to adjust the test display to their preferred settings. Set the brightness and contrast settings of the benchmark display in accordance with the manufacturer's instructions. This shall not be adjusted by the test participant.

> NOTE : Manufacturers should be aware that, if the user is allowed to adjust the display, this may give the user an indication of the display under test and therefore may affect the results of the test. This can be prevented by asking the user to adjust the controls before the test and then performing the test with the controls hidden from view.

Present the five test blocks at the five locations in random order. Instruct the test participant to scan the pseudo-text from the top to the bottom line and indicate each occurrence of the target character. In order to overcome the problem of initial learning effects, train the test participants before the main experiment by performing the task for at least 10 pseudo-texts (i.e. 10 trials). Residual learning shall be controlled by counter-balancing the stimulus order within the main experiment. These practice trials shall use pseudo-text placed in any of the five possible screen locations. Practice trials shall be presented on both test and benchmark displays.

Continue practice trials until the test participant's performance on any one block of pseudo-text is error-free. Do not use data collected from the practice trials to evaluate the quality of the display.

For the experimental trials, measure the time taken for the test participant to identify the presence of the target character in each block of pseudo-text and the number of errors made by the test participant (see clause **C.6**). Allow the test participant a rest break of up to 1 min between trials, with a minimum break of 10 s.

Instruct test participants to respond by pressing predefined keys or buttons to: initiate a trial; count spotted targets; and stop a trial.

A keyboard or any other appropriate input device may be used for this purpose. If the keyboard is used, the **ENTER** key should be defined to initiate/stop a trial, and the space bar should be defined to register spotted targets.

Register the interval between initiation and stopping of a trial as the search time for this trial.

Instruct test participants to work as quickly as possible and to minimize errors as far as possible.

Half of the test participants shall use the benchmark display first, and the other half shall use the test display first.

On completion of the visual search task with a display, ask the test participants to rate the visual quality of that display on a nine-point numerical scale, with 1 being "Poor" and 9 being "Excellent". After completion of the trials with the test display or the benchmark display, ask the test participants to assess the perceptual quality of that display with respect to its visual comfort. The scale to be used is specified below.

The following written instructions shall be given to the test participants to explain how responses are to be made.

"We would like you to indicate how you judge the display you have just used with respect to its visual comfort. You should circle the number corresponding to your judgement."

1	2	3	4	5	6	7	8	9
	Poor			Neutral			Excellent	

NOTE : An example of a set of instructions for test participants is given in **C.5.4**.

C.5.3 Task conditions Display attributes (character size, resolution, visual angle, fonts and so on) of the test display and the benchmark display shall be specified by the manufacturer who nominates the display. These attributes shall be stated in the compliance statement.

— The same font shall be used on both the test and the benchmark display. This font shall be a fixed-width font which complies with the mandatory requirements defined for size, shape and spacing of characters in **5.4**, **5.5**, **5.6**, **5.8**, **5.9**, **5.10**, and **5.11**.

— For each test participant, a fixed target character shall be used over the whole experiment.

— A target character shall have intermediate discriminability with the other characters used (e.g. do not use O, 0 or Q). This test method is not intended to evaluate font design.

Information : Characters having "intermediate discriminability" shall not be too unique nor have too much resemblance to other character(s).

— The number of target-occurrences shall be variable over different pseudo-texts.

— The total number of targets over all trials shall be constant for each display. The test participants shall not be informed about these totals.

— The number of different pseudo-texts per test participant shall be large enough to prevent memorizing effects. An appropriate number is 20 (or less if the number of trials per test participant is less).

— The pseudo-texts shall be presented counterbalanced over all conditions (displays) and/or test participants.

— The test participants should scan the text line-by-line, each line either from left to right or from right to left, according to the direction of reading which they apply in their native language.

— Search time shall begin immediately after the pseudo-text is presented on the display. Search time shall end when the test participant indicates completion of the page of pseudo-text.

— The test participants shall use a button (or key on keyboard) each time a target is spotted. The number of counted targets shall be registered as a check of the test participant's concentration. The performance measurement shall be neglected

from statistical treatment if the recorded number of targets differ by $\geq 10\,\%$ from the actual number of targets in the block.

— The test participants shall use another button (or key) to start/stop time registration.

C.5.4 Instructions to test participants These are sample instructions that should be modified for your own testing situation, e.g. these instructions assume that keyboard input is to be used in a country in which the direction of reading the native language is from left to right. They will need to be modified if a non-keyboard input device or another direction of reading is used.

The instructions shall be presented to the participant on paper, an example of how they may read follows.

"Thank you for taking part in this test. The aim of this test is to evaluate character legibility. Please remember that we are testing the display(s) and not you!

You will be presented with a series of screens similar to the example below. Your task is to find each capital letter "A". This "A" is referred to as a target character. You should read the text from the top left to the bottom right, as if you are reading a normal page of text. When you are ready to start a trial, press the ENTER key on the keyboard. You start your search immediately after a pseudo-text appears on one of five locations on the display (top-left, top-right, bottom-left, bottom-right or in the centre). Whenever you see a capital letter "A", press the space bar on the keyboard. After you have finished reading the entire text, press the ENTER key again. Please work through the screens as quickly and as accurately as possible. The number of targets in each screen varies, so please pay careful attention to properly reading, searching and indicating the presence of the target letter in each screen in the series as quickly and accurately as possible. If you have any questions, please ask the test administrator now."

```
WhwNdzo zltpVY 1CCAe kDw he t3
TkW3rm8U ya BpE O2B L8Y A5 She
PQtb 90DViRCDG 1H pSM yEqZz 6F
jyA3 sATQesa ANUU VLH Oulp2JBE
vbR 11Y5rVr SA9mr DmPETLV 2uO2
7phnFd2oyT 83ee zKo8h KyiTJgAL
vXMu 6Kugm 3ElkxsOWhCK1FTMA T6
LuGF5 ad HsicT HOjkHv ssAq U8Q
8dW rmrtfGqh HCsnGdYIMQEITS fo
ol XVw6 2VogMFo6 PH uJD3c DXj8
yW 5LN 6BvO fGPhdZ Cn x9gUiaH3
fySFoauaxj UeK bKQz 2uZa MmnCN
4t HT3OFuMUSo piqluUh8tdRbK1Tn
Ez 33Q 6w fvVR 7B gyz Ns5 5Ami
7T5k 6bc2 ZH1 fJmDO GwJ9 ECKYm
Xob3m t9 SU ZR el 31Fg 1wc j4w
nToPDF RCUb nyMHs rMIOoizFL8dx
a2Z sD AK5R1 Q8jiI wBeeA L2Rz0
```

C.6 Dependent measures

C.6.1 General Two dependent measures shall be recorded from the experimental trials for each test participant. Data from the practice trials shall not be used in the following analysis.

The dependent measures shall be the following:

a)   the average search velocity obtained from trials with error rates <10 %;

b)   the subjective ratings of visual comfort.

Error rate, E, is defined as:

$$E = \frac{|T_\text{o} - T_\text{c}|}{T_\text{o}} \times 100 \text{ \%}$$

where, T_o :   the total number of target characters in the page of pseudo-text shown to the test participant;

T_c :   the total number of target characters counted by the test participant.

The performance measurement shall be neglected from statistical treatment if the number of missed or extra targets is too large (1 missed or extra target is accepted in a text with 10 targets).

C.6.2   Average search velocity   From the registered search times T_i corresponding with the valid trials ($E < 10$ %) the performance measure of a test participant, the average search velocity, v_s, measured in character(s), is calculated by:

$$v_\text{s} = n_\text{t} \times n_\text{c} \times \left[\sum_{i=1}^{n_\text{t}} T_i\right]^{-1}$$

where, n_t :   the number of valid trials for that test participant;

n_c :   the total number of characters in a pseudo-text (including embedded spaces).

NOTE :   The v_s values for the test and benchmark displays may be analysed by applying a sequential testing procedure for successive test participants (see clause **C.7**).

C.6.3   Subjective ratings   Each test participant shall give, for both the test and the benchmark display, a subjective rating of visual comfort on a 9-point scale.

Information :   These ratings may be analysed using the sequential testing procedure for successive test participants described in **C.7**.

C.7   Statistical treatment of results

C.7.1   General   It is recommended that sequential analysis is used for conducting conformance testing because it can greatly reduce the number of participants required to achieve a statistically reliable test of the null hypothesis.

Information 1   The main feature of sequential analysis is that the sample size is not determined in advance; instead, the validity of the null hypothesis is tested after each set of results has been collected.

2   Other statistical procedures and analysis may be carried out as long as they are of comparable robustness.

If the sequential analysis procedure below is not used, the test and statistical analysis shall ensure that the Type 2 error rate is ≤ 0.05 for a standard deviation, D, of 0.5, and ensure that the criterion α (manufacturer's risk) shall be 0.05 (see table C.1).

Statistical treatment of the results involves comparing the dependant measures for the test display against a benchmark. Since no statistical tests can prove that two products are the same, this test is used to decide if performance for the test product is significantly worse than the benchmark. If the test product is not significantly worse than the benchmark, the test product is considered to conform to this Standard.

Hence, the null hypothesis, H_0, is that the scores of the test display are equal to or better than those for the benchmark display. The alternative hypothesis, H_1, is that the scores for the test display are significantly worse than those for the benchmark display.

C.7.2 General theory Statistical decisions are prone to two kinds of error. The first type of error (Type 1) occurs when the null hypothesis is falsely rejected; the second type of error (Type 2) occurs when the null hypothesis is falsely not rejected. These two risks are usually symbolized by α and β (see table C.1).

Table C.1 The types of decision that can be made using a statistical test

	Decision after testing	
	Test display accepted	Test display rejected
Test display at least as good as benchmark display (H_0)	Correct decision	Error Type 1: manufacturer's risk α
Test display worse than benchmark display (H_1)	Error Type 2: user's risk β	Correct decision

In non-sequential testing, the sample size in an experiment shall be fixed in advance by using the following formula adapted from Hays [31].

$$N = \frac{2(\mu_\alpha + \mu_\beta)^2}{D^2}$$

where, μ_α, μ_β : the normal deviates (z scores) corresponding to α and β respectively;

D : the standard deviation.

For example, if α and β are both set to 0.05 and we wish to detect a difference between the means of half a standard deviation:

$$N = \frac{2(1.65 + 1.65)^2}{0.5^2} = 87.12, \text{ rounded to } 87$$

and hence at least 87 test participants should be tested.

C.7.3 Statistical test Barnard's U test (Barnard, 1946) is used to compare the average search velocities and the ratings of visual comfort for the test and; the benchmark display. Tables C.2 to C.4 provide a step-by-step guide to Barnard's U test, and a worked example.

Table C.2   Description of Barnard's U test

Step	Barnard's U test	
1	(i) Record α, the risk of asserting a significant difference when the displays are the same, and β, the risk of asserting no significant difference when the displays are in fact different, shall both be set to 0.05. (ii) Record D, the difference — in units of standard deviation — between the means that is important to detect shall be set to 0.5.	α, β D
2	For each test participant, obtain a score for the benchmark display (x_0) and for the test display (x_1).	x_0, x_1
3	Compute the difference score.	$x_0 - x_1$
4	Compute F, the sum of the difference scores for all test participants tested.	$F = \Sigma(x_0 - x_1)$
5	Compute S, the sum of the squared differences.	$S = \Sigma(x_0 - x_1)^2$
6	Compute the U statistic.	$U = F/\sqrt{S}$
7	This statistic is then compared with boundary values, U_0 and U_1 according to the appropriate values of α, β and D (see clause **C.10**). If $U < U_0$ then the null hypothesis is not rejected, and the test display passes. If $U > U_1$ then the null hypothesis is rejected in favour of the alternative hypothesis, and the test display fails. If $U_0 \leqq U \leqq U_1$, no decision can be made and testing must continue.	

For example, consider the following worked example, where x_1 and x_0 denote the average search velocities (in characters per second) for a test display and a benchmark display, respectively.

Table C.3 Example of sequential testing using Barnard's U test

N	x_1	x_0	$x_0 - x_1$	F	S	U	U_0 [a]	U_1 [a]
1	9.78	7.92	−1.87	− 1.87	3.50	−1.000		
2	17.19	14.48	−2.70	− 4.57	10.8	−1.391		
3	38.32	39.39	1.08	− 3.49	12.0	−1.007		
4	16.08	14.20	−1.88	− 5.37	15.5	−1.364		
5	13.56	12.17	−1.39	− 6.76	17.4	−1.621		
6	19.57	11.45	−8.12	−14.88	83.4	−1.629	−2.070	
7	6.26	6.38	0.12	−14.76	83.4	−1.616	−1.790	
8	8.20	7.06	−1.14	−15.90	84.7	−1.728	−1.510	2.560
9	24.16	22.23	−1.93	−17.83	88.4	−1.896	−1.330	2.510
10	10.35	7.90	−2.45	−20.28	94.4	−2.087	−1.150	2.460
11	13.83	10.37	−3.46	−23.74	106	−2.306	−1.034	2.436
12	12.21	6.97	−5.24	−28.98	134	−2.503	−0.918	2.412

NOTE: N = The number of test participants (other symbols are explained in table C.2).

Note [a] The critical values are listed in table C.4.

After eight test participants, $U < U_0$; therefore the null hypothesis is not rejected, i.e. the search velocity for the test display is not significantly slower than for the benchmark display and the test display passes this part of the test.

C.8 Conformance Conformance is achieved when both

a)   the search velocity for the test display is not significantly lower than the search velocity obtained with the benchmark display;

b)   the perceived quality of the test display is not significantly lower than the quality of the benchmark display.

C.9 Critical values for Barnard's U test Table C.4 provides critical values for Barnard's U test for $\alpha = 0.05$, $\beta = 0.05$ and $D = 0.5$. These values are interpolated (using linear regression) from table L.3 in Davies [29]. Boundary values, shown in table C.4 in square brackets, are included to assist in the drawing of boundaries and must not be used in making a decision.

Table C.4 Critical values for Barnard's U test

Test participant	U_0	U_1	Test participant	U_0	U_1
2	$[-6.96]$		45	0.79	2.44
3	$[-5.45]$		46	0.816	2.45
4	$[-3.13]$	$[3.01]$	47	0.842	2.46
5	$[-2.6]$	$[2.87]$	48	0.868	2.47
6	-2.07	$[2.73]$	49	0.894	2.48
7	-1.79	$[2.645]$	50	0.92	2.49
8	-1.51	2.56	51	0.944	2.499
9	-1.33	2.51	52	0.968	2.508
10	-1.15	2.46	53	0.992	2.517
11	-1.034	2.436	54	1.016	2.526
12	-0.918	2.412	55	1.04	2.535
13	-0.802	2.388	56	1.064	2.544
14	-0.686	2.364	57	1.088	2.553
15	-0.57	2.34	58	1.112	2.562
16	-0.498	2.334	59	1.136	2.571
17	-0.426	2.328	60	1.16	2.58
18	-0.354	2.322	61	1.18	2.59
19	-0.282	2.316	62	1.2	2.60
20	-0.21	2.31	63	1.22	2.61
21	-0.154	2.308	64	1.24	2.62
22	-0.098	2.306	65	1.26	2.63
23	-0.042	2.304	66	1.28	2.64
24	0.014	2.302	67	1.3	2.65
25	0.07	2.3	68	1.32	2.66
26	0.114	2.304	69	1.34	2.67
27	0.158	2.308	70	1.36	2.68
28	0.202	2.312	71	1.378	2.69
29	0.246	2.316	72	1.396	2.70
30	0.29	2.32	73	1.414	2.71
31	0.328	2.328	74	1.432	2.72
32	0.366	2.336	75	1.45	2.73
33	0.404	2.344	76	1.468	2.74
34	0.442	2.352	77	1.486	2.75
35	0.48	2.36	78	1.504	2.76
36	0.514	2.368	79	1.522	2.77
37	0.548	2.376	80	1.54	2.78
38	0.582	2.384	81	1.557	2.79
39	0.616	2.392	82	1.574	2.80
40	0.65	2.4	83	1.591	2.81
41	0.678	2.408	84	1.608	2.82
42	0.706	2.416	85	1.625	2.83
43	0.734	2.424	86	1.642	2.84
44	0.762	2.432	87	1.659	2.85

7 Replace Annex D (informative) Bibliography with the following:

Annex D (informative)
Bibliography

[1] **ISO 6385** : 1981 *Ergonomic principles in the design of work systems*

[2] **JIS Z 8515** : 2002 *Ergonomics—Office work with visual display terminals (VDTs)—Workstation layout and postural requirements*

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[4] **JIS Z 8518** : 1998 *Ergonomics—Office work with visual display terminals (VDTs)—Requirements for displayed colours*

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8 Replace the title "Informative reference Addendum relating to measuring condition of luminance and luminance meter" with the following:

Annex 1 (informative) Addendum relating to measuring condition of luminance and luminance meter

9 Add the following Annex 2 (informative) after the Informative reference which has been modified to Annex 1 in clause **8**.

Annex 2 (informative)

Comparison table between JIS and corresponding International Standard

JIS Z 8513:1994 *Ergonomics—Office work with visual display terminals (VDTs)— Visual display requirements* JIS Z 8513:2006 *Ergonomics—Office work with visual display terminals (VDTs)— Visual display requirements* (Amendment 1)			ISO 9241-3:1992 *Ergonomic requirements for office work with visual display terminals (VDTs)—Part 3: Visual display requirements* ISO 9241-3:1992 Amendment 1:2000				
(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standard by clause Location of deviation: text, Annex Indication method: dotted underlines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
1 Scope	This Standard specifies image quality requirements for the design and evaluation of single- and multi-colour VDTs.	**ISO 9241-3**	1	Almost identical with **JIS**.	MOD/ addition	**JIS** adds the specifications of the Chinese characters and KANA letters not specified in **ISO**.	The requirements concerning the Japanese function have to be included. The proposal of addition will be studied for the occasion of next review.
2 Definitions	The definitions of main terms are specified.		2	Identical with **JIS**.	IDT	—	—
3 Guiding principles	Design guidance of office working system is specified.		3	Identical with **JIS**.	IDT	—	—
4 Performance requirements	The objectives of this Standard is specified.		4	Identical with **JIS**.	IDT	—	—

(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standard by clause Location of deviation: text, Annex Indication method: dotted under-lines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
5 Design requirements and recommendations	25 items, such as design viewing distance and line-of-sight angle, are specified.		5	Almost identical with **JIS**.	MOD/ addition	**JIS** adds the specifications of the Chinese characters and KANA letters not specified in **ISO**.	The requirements concerning the Japanese function have to be included. The proposal of addition will be studied for the occasion of next review.
6 Measurement conditions and conventions	Measurement conditions and conventions for VDT are specified.		6	Almost identical with **JIS**.	MOD/ addition	**JIS** adds the specifications of the Chinese characters and KANA letters not specified in **ISO**.	The requirements concerning the Japanese function have to be included. The proposal of addition will be studied for the occasion of next review.
Annex C (normative)	Visual performance and comfort test are specified.		Annex C (normative)	Almost identical with **JIS**.	MOD/ addition	**JIS** adds the specifications of the Chinese characters and KANA letters not specified in **ISO**.	The requirements concerning the Japanese function have to be included. The proposal of addition will be studied for the occasion of next review.

Designated degree of correspondence between **JIS** and International Standard: MOD

NOTES 1 Symbols in sub-columns of classification by clause in the comparison table indicate as follows:

— IDT: Identical in technical contents.

— MOD/addition: Adds the specification item(s) or content(s) which are not included in International Standard.

2 Symbol in column of designated degree of correspondence between **JIS** and International Standard in the comparison table indicates as follows:

— MOD: Modifies International Standard.